

Calculation of Value at Risk of Stock Portfolios at Bank Central Asia and Telkom Indonesia Using a Parametric Approach: Modeling Method (Analytical)

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ABSTRACT

The capital market plays an important role in the economy, particularly as a means of investment that is inseparable from risk. One of the main risks in stock investment is market risk arising from stock price fluctuations. Therefore, a risk measurement method is needed that is capable of estimating potential losses quantitatively. This study aims to calculate the Value at Risk (VaR) of the stock portfolios of Bank Central Asia Tbk (BBCA) and PT Telkom Indonesia (Persero) Tbk (TLKM) using a parametric approach through modeling (analytical) methods. The data used consists of daily closing stock prices from July 1, 2022, to December 29, 2022, which were processed into stock return data. Before calculating VaR, the return data was tested for normality using SPSS software to ensure compliance with the normal distribution assumption. Next, VaR was calculated by determining the average portfolio return, portfolio standard deviation, and 95% confidence level. The results of the study indicate that the modeling (analytical) method can be used to effectively estimate the maximum loss risk of the BBCA and TLKM stock portfolios under normal market conditions. The VaR value obtained

can be used as a reference for investors in making investment decisions and in efforts to minimize portfolio risk.

Keywords: Value at Risk, Stock Portfolio, Market Risk, Stocks.

INTRODUCTION

The capital market is one of the important pillars in a country's economic system because it functions as a means of raising funds and a place for investment for the public. Through the capital market, parties with excess funds can channel them to parties in need of funds, particularly companies, with the expectation of obtaining returns in the future. One of the most popular instruments in the capital market is stocks, as they have a relatively high profit potential compared to other investment instruments, although they also carry a high level of risk.

The fluctuating nature of stock prices causes investors to face uncertainty in obtaining returns. These fluctuations are influenced by various factors, both internal to the company and external, such as macroeconomic conditions, government policies, and market sentiment. Therefore, investors are required to have the ability to manage risk so that the investment decisions

they make remain optimal. One strategy commonly used to minimize risk is portfolio formation, which is combining several stock assets with different risk characteristics through the principle of diversification.

In portfolio management, risk measurement is a very important aspect. One of the risk measurement methods widely used in finance is Value at Risk (VaR). Value at Risk is a statistical measure used to estimate the maximum loss that may occur in a portfolio within a certain period of time, at a certain confidence level, and under normal market conditions. VaR is widely used because the results are easy to understand and can be expressed in monetary units, making it easier for investors and risk managers to make decisions.

There are several methods for calculating Value at Risk, including the historical simulation method, the Monte Carlo method, and parametric methods such as variance-covariance and modeling (analytical). The modeling (analytical) method is used with the assumption that stock return data is normally distributed, thus requiring normality testing before calculating VaR. This method is relatively simple and efficient in calculating portfolio risk, especially for assets with stable return characteristics.

Based on this background, this study aims to calculate the Value at Risk of the stock portfolios of Bank Central Asia Tbk (BBCA) and PT Telkom Indonesia (Persero) Tbk (TLKM) using a parametric approach with a modeling (analytical) method. These two stocks were selected because they are large-cap stocks and play an important role in the Indonesian capital market. The results of this study are expected to provide an overview of the magnitude of stock portfolio risk and serve as a consideration for investors in making investment decisions.

LITERATURE REVIEW

A. Definition of Shares

According to [1], shares can be defined as a sign of participation or ownership of

individual investors or institutional investors or traders in their investments or a sum of funds invested in a company. And according to [2], the price of a stock is the value of the stock in rupiah that is formed as a result of the buying and selling of stocks on the stock exchange by fellow exchange members. Based on the two definitions above, it can be concluded that a stock is a sign of ownership by individual or institutional investors of funds invested in a company in the form of securities whose function is as a marker of one of the owners of the company's assets [3].

B. Stock Price

The stock price is the price of a company's shares used as an indicator of the success of the company's management at a certain time in the capital market, which is determined by the buying and selling of shares [4].

C. Types of Stock Prices

There are several types of stock prices on the IDX. There are four types of stock prices in candlestick charts, namely:

1. The opening price is the first price of a stock at the start of trading. Trading on the Indonesia Stock Exchange begins at 9:00 a.m. Western Indonesian Time.
2. The high price is the highest price that has ever occurred in a single day of stock trading on the stock exchange.
3. The low price is the lowest price that has ever occurred in a single day of stock trading on the stock exchange.
4. The closing price is the last price at which a stock is traded at the end of the trading day. The Indonesia Stock Exchange closes at 4:00 p.m. WIB.

D. Stock Investment

Investment is an activity of placing funds in one or more types of assets for a certain period with the expectation of obtaining income and/or an increase in the value of the investment in the future. Investments are made to meet the needs and desires of individuals, groups, and countries [5]. Basically, an investor buys a number of shares at the present time with the hope of profiting from an increase in the share price or a number of dividends in the future, in

return for the time and risk associated with the investment.

E. Stock Portfolio

A portfolio is a collection of investment assets in the form of shares, either owned by individuals or companies. An investor must first determine an efficient portfolio before forming an optimal portfolio. An efficient portfolio is one that provides the highest rate of return with the same risk or the lowest risk with the same rate of return [6], while according to [7], an efficient portfolio is one that optimizes only one of the expected return or portfolio risk, while an optimal portfolio optimizes both. The use of investment feasibility analysis methods through the formation of an optimal portfolio will help investors in making decisions on which portfolio to choose, thereby providing the highest expected return with a certain level of risk, or the lowest risk with a certain expected return from the portfolio formed.

F. Investment Risk

All forms of investment involve risk or uncertainty of results [8]. According to [9], risk is the possibility of results deviating from expectations. The amount of expected profit from each security is not the same, depending on the amount of risk borne by the investor. However, what investors can do is minimize risk by considering the magnitude of each factor. In portfolio theory, risk is the degree of deviation from expected returns. Risk in investment arises due to uncertainty regarding the timing and amount of returns that investors will receive.

According to [10], the factors that cause risk will affect the deviation of the realized return on an investment from the expected return. Sources of risk include the following:

1. Interest rate risk, which is the risk caused by changes in savings interest rates and loan interest rates.
2. Market risk, which is the risk caused by the variability of an investment's return as a result of fluctuations in overall market transactions.

3. Inflation risk, which is the risk caused by a decline in people's purchasing power as a result of a general increase in the prices of goods.
4. Business risk, which is the risk caused by increasingly difficult business challenges faced by companies, whether due to increasingly fierce competition, changes in government regulations, or claims from the public against companies for damaging the environment.
5. Financial Risk, which is the financial risk associated with the capital structure used to fund the company's activities.
6. Liquidity risk, which is the risk associated with difficulties in liquidating a portfolio or selling shares because there are no buyers for those shares.
7. Exchange rate risk or currency risk. For investors who invest in various countries with different currencies, changes in currency exchange rates will be a factor causing real returns to be smaller than expected returns.
8. Country risk. This risk is also related to cross-country investments caused by political, security, and economic stability conditions. The more unstable the security, politics, and economy of a country, the higher the risk of investing in that country because investment returns become more uncertain, so the compensation or return demanded on an investment becomes higher.

The source of risk that correlates with this writing is Market Risk. This is because the data taken is data from market transaction fluctuations within a certain period of time.

G. Return

Stock return is the expected rate of return on investments made in stocks or several groups of stocks through a portfolio [11]. Stock return is the rate of return in the form of profits or losses received by investors during certain periods. Stock Return can be in the form of dividends, which are company profits received by investors in cash, shares, or property, and capital gains,

which are the difference between the purchase price and the selling price [12].

H. Value at Risk

According to [13], Value at Risk or VaR is a statistical risk measurement method that estimates the maximum loss that may occur on a portfolio at a certain confidence level. VaR calculations are usually presented in monetary terms rather than percentages, making VaR very easy to understand.

There are several methods for calculating VaR. These methods are distinguished based on the data used. If the data used in the calculation is normally distributed, then the method used is a parametric approach, such as modeling and variance-covariance methods. If the data used in the calculation is not normally distributed, then the method used is a non-parametric approach, such as the historical simulation method.

I. Modeling Method (analytical)

The modeling method (analytical) is a method used in calculating the Value at Risk of a stock portfolio with normally distributed data. Therefore, when performing calculations using this method, it is necessary to test the normality of the stock data. Normality testing can be done using SPSS software. After testing the normality of the data, the following steps can be taken:

1. Calculation of portfolio mean return

Mean Return
 Portofolio = $X_A(R_A) + X_B(R_B)$

Description:

X_A = Comparison of the number of shares purchased in company A.

X_B = Comparison of the number of shares purchased in company B.

R_A = Average return on shares A.

R_B = Average return on shares B.

2. Determine the standard deviation of the two-asset portfolio

$$\sigma_p = \{X_X^2\sigma_X^2 + X_Y^2\sigma_Y^2 + 2X_XX_Y\Gamma_{XY}\sigma_X\sigma_Y\}^{1/2}$$

Description:

σ_p = portfolio standard deviation

σ_X, σ_Y = standard deviation of each return of PT. A and PT. B

Γ_{XY} = correlation between asset A return and asset B return

3. Calculate 95% VaR

$$VaR = (\text{mean} - (\text{std.deviasi} \times z_{1-\alpha})) \times V_0$$

Description:

V_0 = total purchase price of shares.

MATERIALS & METHODS

A. Research Materials

The data used for VaR calculations using the Modeling (Analytical) method on multiple assets (portfolio) is return data obtained from the calculation of the daily closing price of shares of Bank Central Asia Tbk (BBCA) and PT Telkom Indonesia for the period from July 1, 2022 to December 29, 2022.

B. Research Variables

This study uses two data variables, namely closing price and stock return. The researcher uses these two variables as the basis for calculating VaR using the modeling (analytical) method.

C. Data Collection Method

This report uses secondary data on Bank Central Asia Tbk (BBCA) and PT Telkom Indonesia shares obtained from the website <https://www.investing.com/>.

D. Data Processing Method

In this study, the researcher used Ms. Excel software to process the data obtained, namely the closing price. The closing price data was processed to obtain the stock return value. The researcher used this software to facilitate numerical data calculations. The data obtained from processing the data from Ms. Excel (return) will be processed using SPSS software to test the normality of the data. If the data is determined to be normally distributed, the modeling (analytical) method can be used in calculating VaR for Bank Central Asia Tbk (BBCA) and PT Telkom Indonesia stocks. Since the modeling (analytical) method can be used, the calculation of the formula provided will be continued.

RESULT

A. Calculation of Value at Risk (VaR) for the Stock Portfolios of Bank Central Asia and Telkom Indonesia (Persero) Tbk PT (TLKM)

1. Return Values for Bank Central Asia and Telkom Indonesia (Persero) Tbk PT (TLKM) Stocks

The return values were obtained from the following calculations.

$$\text{Return} = \frac{A_1 - A_0}{A_0}$$

Explanation:

A_1 : today's closing price

A_0 : previous day's closing price

Thus, the return value of Bank Central Asia and Telkom Indonesia shares is as follows.

Table 2. Bank Central Asia and Telkom Indonesia share return data

No.	Bank Central Asia Tbk (BBCA) <i>Return</i>	Telkom Indonesia (Persero) Tbk <i>Return</i>
1		
2	-0.027586207	-0.007462687
3	0.028368794	0
4	0.006896552	0.007518797
5	-0.02739726	0.004975124
6	0.007042254	-0.007425743
7	-0.003496503	0.007481297
8	0.007017544	-0.007425743
9	-0.024390244	-0.017456359
10	0.003571429	0.020304569
11	-0.003558719	0.032338308
12	0.021428571	0.009638554
13	0.003496503	-0.007159905
14	0.031358885	0.012019231
15	0	0.011876485
16	-0.010135135	-0.007042254
17	-0.003412969	0.002364066
18	0	0.002358491
19	0.003424658	0.011764706
20	0.003412969	-0.013953488
21	0	-0.002358491
22	0.020408163	0.016548463
23	0.013333333	0.034883721
24	0.003289474	0.011235955
25	0.02295082	0.011111111
26	0.009615385	0.021978022
27	0	0.010752688
28	0.003174603	-0.012765957
29	0	-0.017241379
30	0.006329114	0.002192982
31	-0.003144654	-0.004376368
32	0.003154574	-0.021978022
33	0.003144654	-0.008988764
34	0.003134796	0.031746032
35	-0.0125	0.010989011
36	0.012658228	0.010869565
37	-0.0125	0.002150538
38	0.006329114	0.019313305
39	0.01572327	-0.037894737
40	-0.009287926	-0.01750547
41	0.01875	0.006681514
42	0.003067485	-0.008849558
43	0.003058104	0.017857143

44	-0.006097561	0.004385965
45	0.009202454	0.004366812
46	0.006079027	0.004347826
47	0	-0.023809524
48	0.012084592	-0.00443459
49	-0.002985075	0.0155902
50	0.002994012	0.00877193
51	0	-0.013043478
52	0.017910448	-0.004405286
53	-0.002932551	-0.008849558
54	0.029411765	0.004464286
55	-0.034285714	-0.02
56	0.023668639	0.020408163
57	-0.011560694	-0.004444444
58	-0.00877193	-0.011160714
59	0	0
60	-0.01179941	-0.011286682
61	0.005970149	0.01826484
62	-0.014836795	-0.004484305
63	0.003012048	0.006756757
64	0.006006006	-0.006711409
65	0.020895522	0.004504505
66	-0.005847953	0
67	0.005882353	-0.004484305
68	-0.011695906	0.004504505
69	-0.00295858	-0.006726457
70	-0.026706231	-0.018058691
71	0.012195122	0.016091954
72	-0.006024096	-0.024886878
73	0.009090909	0.006960557
74	-0.006006006	-0.00921659
75	-0.003021148	-0.002325581
76	0	0.009324009
77	0.006060606	-0.018475751
78	-0.003012048	-0.011764706
79	0.027190332	0.035714286
80	0.017647059	0.002298851
81	0.028901734	0.01146789
82	-0.02247191	-0.004535147
83	-0.017241379	-0.004555809
84	0.01754386	0
85	0.005747126	0.018306636
86	0.005714286	-0.013483146
87	0	0.006833713
88	-0.005681818	-0.045248869
89	0.005714286	-0.021327014
90	-0.002840909	0.01937046
91	0.008547009	0.016627078
92	-0.011299435	-0.014018692
93	0.014285714	-0.007109005
94	-0.008450704	-0.00477327
95	0.005681818	-0.004796163
96	-0.011299435	-0.024096386
97	0.005714286	0
98	-0.022727273	0
99	0.014534884	-0.002469136
100	0.011461318	-0.007425743
101	-0.011331445	0.004987531

102	0.020057307	-0.007444169
103	-0.002808989	-0.0075
104	0.014084507	0.01511335
105	-0.002777778	0
106	0.005571031	-0.012406948
107	-0.005540166	0
108	0.036211699	0.015075377
109	-0.032258065	-0.01980198
110	-0.011111111	0.01010101
111	-0.014044944	-0.04
112	-0.011396011	-0.0625
113	-0.025936599	0.022222222
114	0.00591716	0.016304348
115	0.008823529	-0.024064171
116	0.014577259	0.01369863
117	0	0.013513514
118	-0.00862069	0
119	-0.014492754	-0.021333333
120	0.011764706	0.002724796
121	0.005813953	0.010869565
122	-0.00867052	0
123	0.011661808	0.018817204
124	-0.011527378	-0.01055409
125	-0.008746356	0.008
126	0.008823529	-0.007936508
127	0.002915452	0.016
128	0.005813953	-0.020997375
129	-0.00867052	0.013404826
130	-0.002915452	-0.007936508
131	0	0.013333333
132	0	0.015789474
133	-0.023391813	-0.010362694
134	-0.011976048	-0.013089005
135	0.006060606	-0.015915119
136	0.018072289	0.021563342
137	-0.032544379	0.01055409
138	-0.006116208	0.010443864
139	0.006153846	-0.002583979
140	-0.01529052	-0.020725389
141	0.01242236	0.018518519
142	0.021472393	0.025974026
143	-0.003003003	-0.005063291
144	0.003012048	-0.010178117
145	-0.003003003	-0.005141388
146	-0.009036145	-0.005167959
147	-0.003039514	-0.002597403
148	0.033536585	0.033854167
149	0.026548673	-0.002518892
150	0	0
151	-0.025862069	-0.027777778
152	0.002949853	0.005194805
153	-0.005882353	0.005167959
154	0.029585799	-0.002570694
155	0.002873563	0
156	0.014326648	-0.020618557
157	-0.002824859	0.010526316
158	0.008498584	-0.018229167
159	-0.008426966	0.00795756

160	0.005665722	-0.002631579
161	0.008450704	0.002638522
162	-0.008379888	-0.002631579
163	-0.01971831	-0.005277045
164	0.002873563	-0.00265252

2. Kolmogorov-Smirnov Normality Test of Stock Return Data

Modeling methods can be used if the data obtained is normally distributed. Therefore, a Kolmogorov-Smirnov normality test will

be performed using SPSS software on both Bank Central Asia and Telkom Indonesia stock return data. The following output was obtained from the test.

Table 3. Kolmogorov-Smirnov Normality Test for Bank Central Asia Stock Return Data

One-Sample Kolmogorov-Smirnov Test		
		Return_BCA
N		163
Normal Parameters ^{a,b}	Mean	.00123017117
	Std. Deviation	.013711528409
Most Extreme Differences	Absolute	.073
	Positive	.073
	Negative	-.063
Test Statistic		.073
Asymp. Sig. (2-tailed)		.035 ^c
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

Testing procedure for normally distributed return data:

i. Hypothesis:

H_0 : Return data is normally distributed

H_1 : Return data is not normally distributed

ii. Significance level:

$\alpha = 0.05$

iii. Calculation

The SPSS output shows Asymp. Sig (2-tailed) = 0.035

iv. Rejection criteria:

If sig. > α then H_0 is accepted.

If sig. < α then H_0 is rejected.

v. Conclusion

Because sig. > α , then H_0 is accepted. This means that the return data is normally distributed.

Table 3. Kolmogorov-Smirnov Normality Test of Return Data for Bank Central Asia and Telkom Indonesia Stocks

One-Sample Kolmogorov-Smirnov Test		
		Return Telkom
N		163
Normal Parameters ^{a,b}	Mean	-.00029349840
	Std. Deviation	.015277293314
Most Extreme Differences	Absolute	.057
	Positive	.044
	Negative	-.057
Test Statistic		.057
Asymp. Sig. (2-tailed)		.200 ^{c,d}
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		
d. This is a lower bound of the true significance.		

Testing procedure for normally distributed return data:

i. Hypothesis:

H_0 : Return data is normally distributed

H_1 : Return data is not normally distributed

ii. Significance level:

$\alpha = 0.05$

iii. Calculation

The SPSS output shows Asymp. Sig (2-tailed) = 0.200

iv. Rejection criteria:

If sig. > α , then H_0 is accepted.

If sig. < α , then H_0 is rejected.

v. Conclusion

Since sig. > α , then is accepted. This means that the return data is normally distributed. Since both data sets are normally distributed, VaR calculations using the modeling method can be performed.

B. VaR Calculations Using the Modeling Method

The following is the Value at Risk (VaR) calculation using the Modeling (Analytical/Parametric) method based on BBCA and TLKM stock return data that has been tested for normality and declared to be normally distributed, making this method applicable. The calculation is performed at a 95% confidence level with a value of ($Z_{0,95} = 1,645$) and assumes an initial investment value of IDR 100,000,000 for each stock.

Based on the results of the Kolmogorov–Smirnov normality test on Bank Central Asia (BBCA) stock return data, a mean (μ) value of 0.00123017117 and a standard deviation (σ) value of 0.013711528409 were obtained. Using the VaR modeling method formula ($VaR = \mu - Z_{\alpha} \sigma$) V_0 , the product of Z and the standard deviation is first calculated, which is $1.645 \times 0.013711528409 = 0.022554$. Next, this value is subtracted from the mean return to obtain $0.00123017117 - 0.022554 = -0.021323829$. This value is then multiplied by the initial investment value of IDR 100,000,000 to obtain a VaR of $-0.021323829 \times 100,000,000 = -IDR 2,132,382.9$. Thus, the Value at Risk of

BBCA shares at a 95% confidence level is approximately Rp 2,132,383. This means that with a 95% confidence level, the maximum potential loss that can occur in one period (daily) on an investment of Rp 100,000,000 in BBCA shares is approximately Rp 2.13 million.

Next, for Telkom Indonesia (TLKM) shares, based on the SPSS output, the mean return (μ) is -0.00029349840 and the standard deviation (σ) is 0.015277293314. Using the same formula, first calculate $1.645 \times 0.015277293314 = 0.025141148$. Then, the mean return was subtracted from this result, which was $-0.00029349840 - 0.025141148 = -0.0254346464$. This value is then multiplied by the initial investment value of IDR 100,000,000 to obtain a VaR of $-0.0254346464 \times 100,000,000 = -IDR 2,543,464.64$. Thus, the Value at Risk of TLKM shares at a 95% confidence level is approximately Rp 2,543,465. This means that with a 95% confidence level, the maximum potential loss in one period on an investment of Rp 100,000,000 in TLKM shares is approximately Rp 2.54 million.

Based on these calculations, it can be concluded that the VaR value of TLKM shares is greater than that of BBCA. This difference is due to the higher standard deviation of TLKM returns compared to BBCA, which indicates that the volatility of TLKM returns is greater, resulting in a higher maximum risk of loss.

DISCUSSION

The results of the study indicate that the Modeling (Parametric/Variance–Covariance) method is capable of quantitatively measuring the market risk level of BBCA and TLKM stocks through a normal distribution approach. Based on the Kolmogorov–Smirnov normality test conducted previously, the return data for both stocks are declared to be normally distributed, thus fulfilling the main assumption in the use of the parametric VaR method. This is important because the modeling method assumes that returns follow a normal distribution with mean and

standard deviation parameters as the main measures of risk characteristics.

Based on the calculation results, the VaR value at a 95% confidence level for BBCA shares is IDR 2,132,383, while for TLKM shares it is IDR 2,543,465, assuming an initial investment value of IDR 100,000,000. The difference in VaR values reflects the difference in the volatility levels of each stock. The higher standard deviation of TLKM returns compared to BBCA indicates that TLKM price fluctuations are relatively greater, so the maximum potential loss that may occur in normal market conditions is also greater. Thus, statistically, TLKM has a higher market risk level than BBCA during the research period.

In addition, BBCA's positive mean return indicates that, on average, the stock provides a profit, while TLKM has a negative mean return, albeit a small one. This condition also affects the VaR calculation results because, in the modeling method, the mean value is part of the risk calculation component. However, in short-term risk management practices, the influence of standard deviation (volatility) tends to be more dominant than mean return, especially when the observation period is daily.

The results of this study also show that the higher the confidence level, the greater the VaR value obtained. This is in line with risk management theory, which states that an increase in the level of confidence in the maximum loss estimate will expand the potential loss limit. Therefore, the selection of the confidence level is an important factor in the risk management policies of companies and individual investors.

In practical terms, these results imply that investors with low risk preferences (risk averse) tend to favor stocks with lower VaR values, in this case BBCA. Meanwhile, TLKM stocks, despite having higher risk, have the potential to provide greater returns if volatility is followed by favorable price movements. Thus, investment decisions should not only consider potential returns,

but also quantitative measures of risk such as VaR.

Although the modeling method has advantages in terms of ease of calculation and analytical efficiency, it has limitations because it assumes a normal distribution and is unable to fully capture the tail risk that often occurs in financial markets. Therefore, for further research, it is recommended to use other methods such as Historical Simulation or Monte Carlo Simulation as a comparison to obtain a more comprehensive picture of risk.

This study shows that the Modeling (Parametric) method is effective for measuring the market risk of BBCA and TLKM stocks and provides quantitative information that can be used as a basis for investment decision-making and risk management.

CONCLUSION

Based on the results of the research conducted, it can be concluded that the Modeling (Parametric/Variance–Covariance) method is effective for measuring market risk in Bank Central Asia (BBCA) and Telkom Indonesia (TLKM) stocks. The normality test results show that the return data for both stocks is normally distributed, thus fulfilling the basic assumption in the use of the parametric VaR method. The Value at Risk (VaR) calculation at a 95% confidence level with an investment value of IDR 100,000,000 resulted in a VaR of IDR 2,132,383 for BBCA shares and IDR 2,543,465 for TLKM shares. These values represent the maximum potential loss that may occur in one period with a 95% confidence level.

The difference in VaR values between the two stocks shows that TLKM has a higher level of risk than BBCA during the research period. This is due to the greater standard deviation of TLKM returns, which reflects higher price volatility. Thus, although both stocks are classified as blue-chip stocks, their risk characteristics remain different. These results confirm that volatility is a

major factor in determining the magnitude of market risk in the parametric approach.

This study implies that risk measurement using the VaR method can be an effective tool in assisting investors and investment managers in decision-making. Information about maximum potential losses allows investors to adjust their investment strategies in line with their risk profiles. However, because modeling methods have limitations in capturing extreme risks due to normal distribution assumptions, further research is recommended to combine this approach with other methods in order to obtain more comprehensive and robust risk measurement results.

Declaration by Authors

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